

# Fabrication

## #11 Machining

This brief gives advice for:

- Equipment
- Procedures
- Trouble Shooting
- Equipment Suppliers
- Additional Technical Information and Assistance

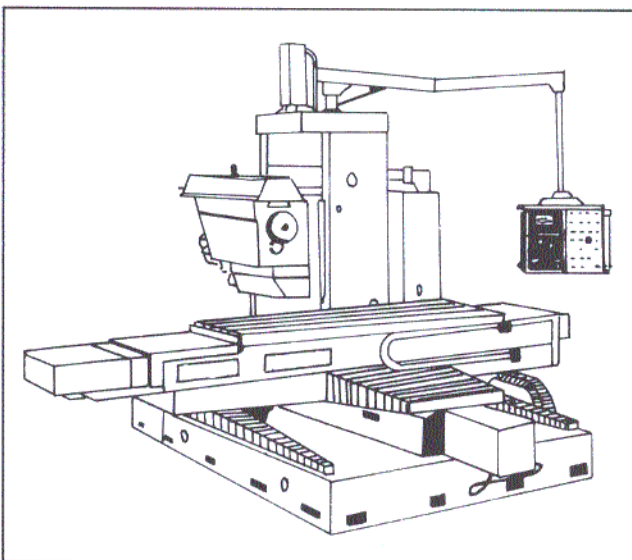
### Equipment

Many types of machining equipment are used in fabricating ACRYLITE FF sheet products. Included are millers, grinders, thread cutters, engraving equipment, files, and reamers.

Most equipment used in machining ACRYLITE FF sheet was originally designed for wood or metal. Notching or overheating sheet due to inadequate equipment or improper cutting tools may cause failure of the fabricated item. To prevent this, make sure equipment is right for ACRYLITE FF sheet.

### Milling Machines

Various kinds of machines are available for milling ACRYLITE FF sheet. Machines with a heavy base and reliable balance are needed to control



vibration and assure clean cuts. Equip all units with vacuum devices or compressed air to clear chips and cuttings from the blade area, and to control heat generation.

### Milling Tools

Milling cutters vary widely, depending on the application. Cutting edge rake angle should be 0–5° and clearance angle 2–10°. You can machine ACRYLITE FF sheet with high speed steel, carbide, or diamond-tipped tools.

Carbide tools, though they have a higher initial cost than steel, maintain a sharp edge longer, producing a high-quality machined edge for a longer time. Diamond-tipped tools produce a superior cut and last even longer than carbide-tipped tools. Pigments in ACRYLITE FF sheet colors may shorten tool edge life.

### Filing-Shaving

You can use most normal files, hand routing files, and rasps with ACRYLITE FF sheet. The tool depends on the desired effects and the application. Use these tools for producing a rough surface, not for fine finishing.

### Engraving Equipment

For artistic work, use flexible shaft engravers rotating at least 1000 rpm and air-operated pencil milling and grinding tools rotating about 6000 rpm.

### Reamers

Use normal reamers for deburring drilled holes. Be sure all tool edges are fault-free, preventing grooves or furrows in the drilled surface.

### Thread Cutters

Use normal taps and dies to cut internal and external threads in ACRYLITE FF sheet. Most machine cutters are suitable.

### Procedures

#### Safety

**When using machining equipment, wear a protective face shield or safety goggles. Wear**

**hearing protection if you will be operating equipment for a long time.**

Follow normal workshop safety practices when machining ACRYLITE FF sheet. Eye, ear, and respiratory protection may be appropriate, depending on the operation.

**Be sure to follow manufacturers' safety recommendations for equipment and materials used with ACRYLITE FF acrylic sheet.**

**Direction of Travel**

To achieve a smooth cut, feed the sheet in the proper direction as required by the tool rotation. Feed material into the rotating edge of the cutter.

**Dimensional Changes**

Stresses inherent in ACRYLITE FF sheet, as well as stresses imparted to fabricated articles by machining, may cause dimensional changes when sheet is heated to the forming temperature (300°F) after machining.

Anneal the part to eliminate stresses. See Fabrication Tech Brief #12, Annealing.

**Lathe Operation**

To use a single-edged cutter, carefully balance the chuck with adjusting screws to eliminate chatter marks. Edge quality will depend largely on the machine's stability.

**Milling Tools**

Use a multi-edged milling tool. The cutter's rotation speed should be as fast as possible, at least 3300 feet per minute.

As most blades are designed for machining wood or metal, modifications may be necessary. The rake angle should be 0°, reducing chipping by providing a scraping, rather than cutting, action. The clearance angle should be at least 2°—usually more—to minimize frictional heat buildup.

If you're using a standard milling tool, provide cooling.

**Cooling**

Plastics, including ACRYLITE FF acrylic sheet, are much more susceptible to heat distortion than metals. Use coolants such as compressed air, water, emulsions, etc., to minimize heat distortion effects and produce a polished surface. If cooling is not provided, decomposition and irregularities at the cut edge may produce high-stress areas, leading to crazing (numerous tiny cracks in the material).

If you use emulsions, have them tested for compatibility with acrylic. Incompatible emulsions may cause crazing. The CYRO Technical Center in Orange, Connecticut, can test emulsions—see the address and phone number at the end of this brief.

**Filing-Shaving**

If necessary, use a scraper made of high-speed steel to smooth sawn edges, eliminating notching. Flat-ground triangular files with a maximum edge width of 8mm (3/10") are also effective. The file surface must not be hollow ground, as this will produce chatter marks due to the rake angle. A flat-ground file should have a 0° rake angle. As with sanding, use water for a smooth finish and less stress buildup from frictional heat.

**Engraving**

Use hand-held tools for artistic applications and fixed-tracing engravers for precise work. Adjust the engraving tip's travel speed to avoid melting (whitening of the surface) from slow travel and chipping from fast travel. If melting persists, use a liquid coolant or air cooling.

**Thread Cutting**

Due to the notch sensitivity of acrylics, don't machine threads with sharp edges. To reduce stresses, use rounded threads. Note, too, that threads should not be intended to bear loads. If threaded connections will often be unscrewed, reinforce the internal thread with a metal insert.

Use a cutting emulsion or oil to produce a polished surface. Regularly remove chips from internal holes, and don't allow the tap to "bottom out."

**Trouble Shooting**

<u>Problem</u>	<u>Cause</u>	<u>Solution</u>	
<b>Chatter marks</b>	Dull tool	Replace or sharpen tool	
	Feed rate too fast	Reduce feed rate	
	Unbalanced chuck	Balance chuck with adjusting screws or replace chuck and spindle	
	Vibration	Stabilize platform	
	Bearing wear	Replace when runout exceeds 0.002"	
	Incorrect rake angle	Use tool with 0° rake angle	
	<b>Melted edges</b>	Dull tool	Replace or sharpen tool
		Slow feed rate No cooling	Increase feed rate Add compressed air, water mist, or emulsion cooling
	Chip buildup	Use vacuum system or compressed air to clear chips	

<b>Problem</b>	<b>Cause</b>	<b>Solution</b>
<b>Melted edges</b>	Incorrect rake angle Incorrect clearance angle	Use tool with 0° rake angle Use tool with 2-10° clearance angle

### **Equipment and Materials Suppliers**

The suppliers listed below offer materials and equipment which works well with ACRYLITE FF sheet. Authorized ACRYLITE FF sheet distributors may also offer materials and equipment.

#### **Cooling Apparatus**

*Spra-Kool Midget Economy Model 58*

Bar Products Co.  
1923 N. Church St.  
Rockford, IL 61103  
(815) 229-4063

*Cold Air Gun Model 610*

ITW Vortec Corp.  
10125 Carver Rd.  
Cincinnati, OH 45242-4798  
(513) 891-7474

#### **Cutting Emulsion**

*Oakite Formula MMOF (20 parts water to 1 part MMOF)*  
Oakite Products, Inc.  
Berkeley Heights, NJ 07922  
800-526-4473 or (908) 464-6900

#### **Milling Machines, Cutters, & Files**

Consult the THOMAS REGISTER OF AMERICAN MANUFACTURERS

### **Additional Technical Information and Assistance**

#### **Technical Literature Available**

For more detailed information, see your local Authorized ACRYLITE Sheet Distributor or contact CYRO Industries. Literature is available for these and other topics:

##### **Physical Properties —**

#1121 — "Physical Properties of ACRYLITE FF Acrylic Sheet"

##### **Fabrication Tech Briefs —**

These cover individual operations of fabrication such as cutting, drilling, thermoforming, etc. Be sure to ask for the latest listing of available Tech Briefs from your ACRYLITE sheet distributor or CYRO Industries.

##### **Application Tech Briefs —**

These cover required fabrication operations for specific applications like glazing, signs, etc.

### **Technical Service**

For complete technical assistance contact CYRO Industries, Technical Service:

CYRO Industries  
25 Executive Blvd.  
Orange, CT 06477  
(203) 795-6081

#### *In Canada:*

**CYRO Canada Inc.**  
6285 Northam Drive  
Suite 100  
Mississauga,  
Ontario L4V 1X5  
(905) 677-1388  
(800) 268-4743

### **Offices**

For the name of your local Authorized Distributor call toll-free 1-800-631-5384 or contact the nearest CYRO office:

**Rockaway, NJ 07866**  
100 Enterprise Drive  
(973) 442-6130

**Naperville, IL 60563**  
280 Shuman Blvd.  
(630) 357-0822

**Plano, TX 75074**  
101 East Park Blvd.  
Suite 1039  
(214) 424-6830

**San Ramon, CA 94583**  
3180 Crow Canyon Place  
Suite 240  
(510) 866-9300

#### *In Canada:*

**CYRO Canada Inc.**  
6285 Northam Drive  
Suite 100  
Mississauga,  
Ontario L4V 1X5  
(905) 677-1388  
(800) 268-4743

### **Fire Precautions**

ACRYLITE FF acrylic sheet is a combustible thermoplastic. Precautions should be taken to protect this material from flames and high heat sources. ACRYLITE FF acrylic sheet usually burns rapidly to completion if not extinguished. The products of combustion, if sufficient air is present, are carbon dioxide and water. However, in many fires sufficient air will not be available and toxic carbon monoxide will be formed, as it will when other common combustible materials are burned. We urge good judgement in the use of this versatile material and recommend that building codes be followed carefully to assure it is used properly.

### **Compatibility**

Like other plastic materials, ACRYLITE FF sheet is subject to crazing, cracking, or discoloration if brought into contact with incompatible materials. These materials may include cleaners, polishes, adhesives, sealants, gasketing or packaging materials, cutting emulsions, etc. See the Tech Briefs in this series, particularly #1, Handling and Maintenance, for more information or contact your ACRYLITE Sheet Distributor or the CYRO Technical Center for information on a specific product.

**Important Notice:** The information and statements herein are believed to be reliable but are not to be construed as a warranty or representation for which we assume legal responsibility. Users should undertake sufficient verification and testing to determine the suitability for their own particular purpose of any information or products referred to herein. **NO WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE IS MADE.** Nothing herein is to be taken as permission, inducement or recommendation to practice any patented invention without a license.



CYRO Industries, Rockaway, NJ 07866